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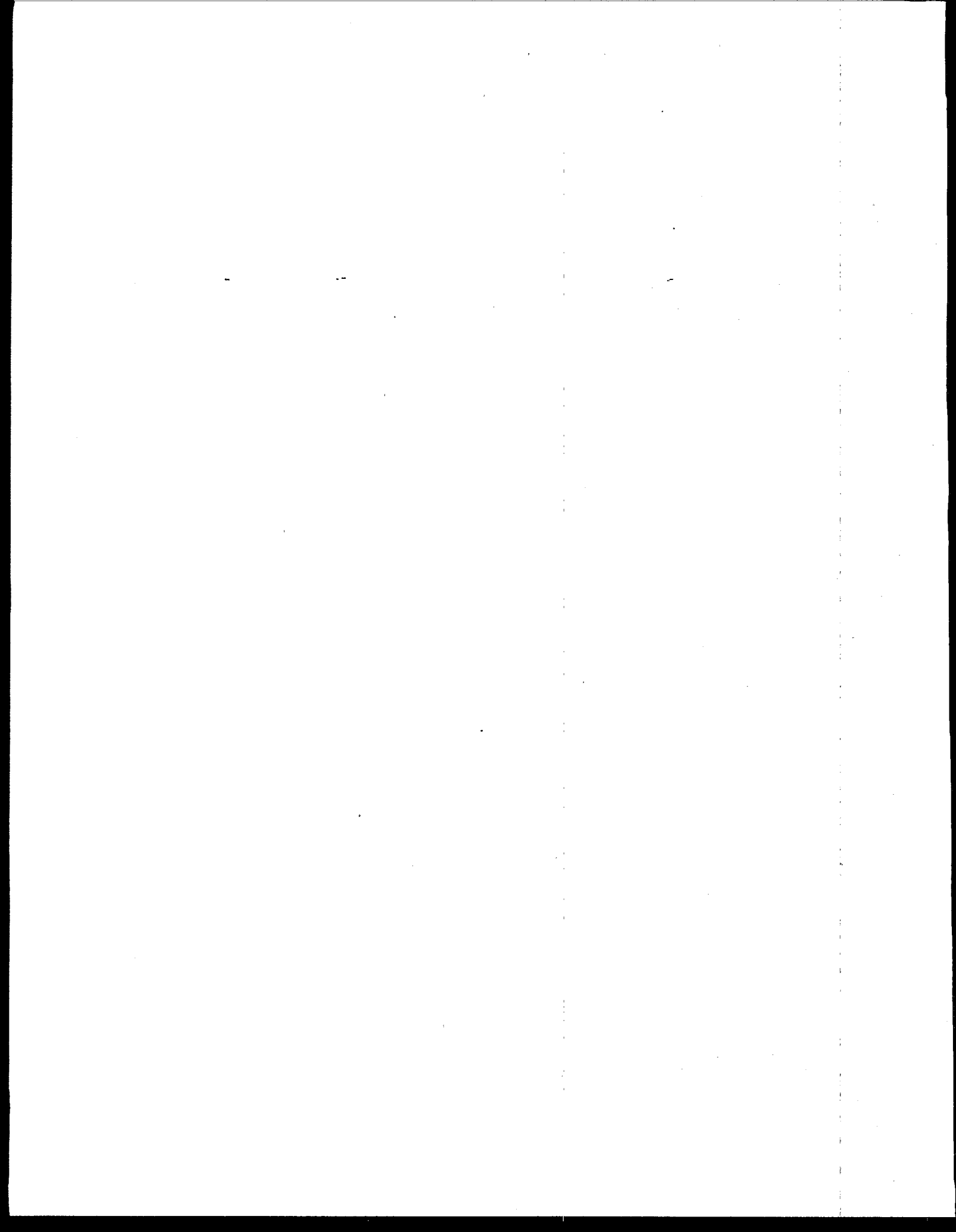
Air and Radiation  
(6205J)

EPA 430-R-96-008  
April 1996

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# **Moving to Alternative Refrigerants: Update**

Six Case Histories--  
Comfort Coolers and  
Commercial Refrigeration



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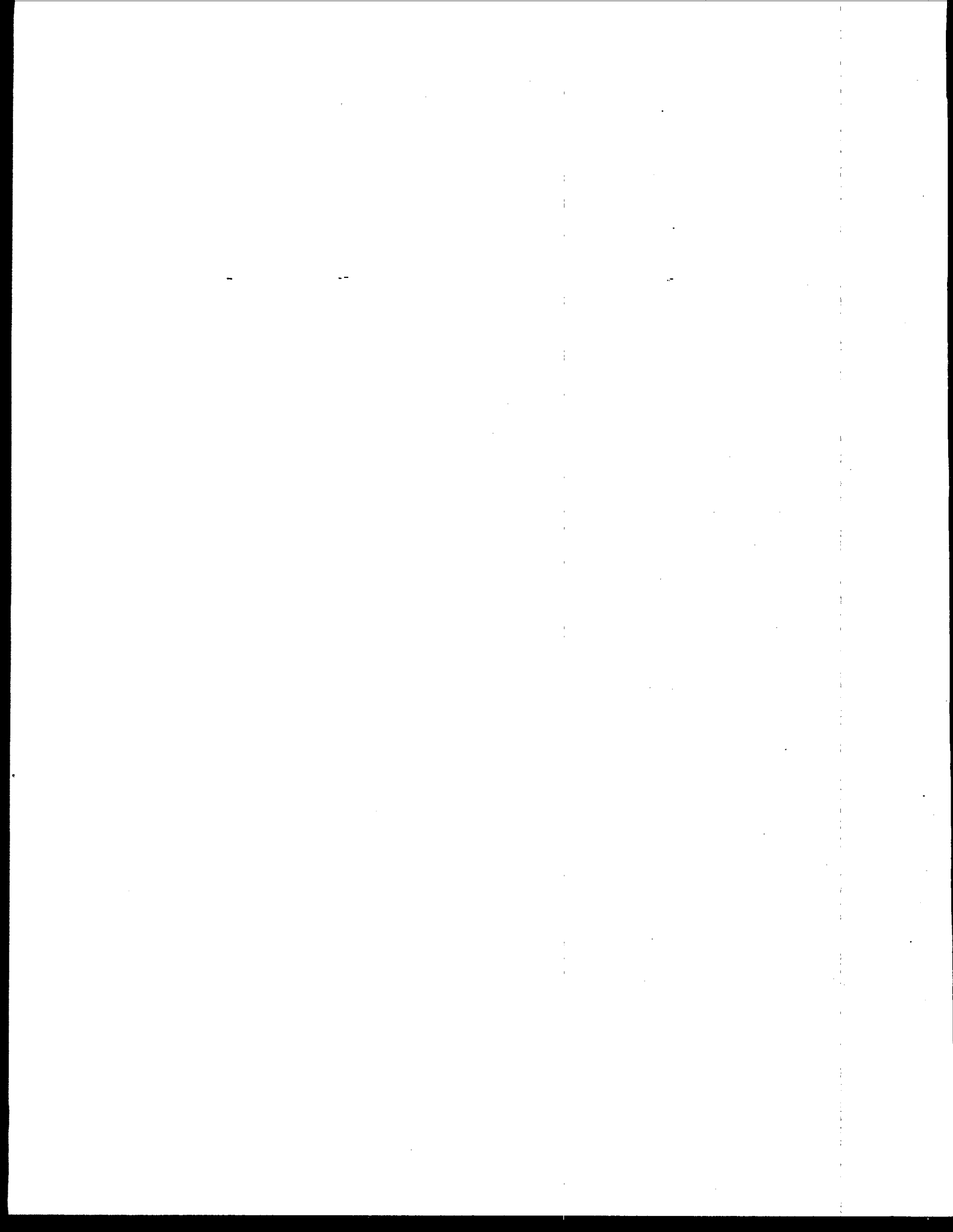
# Foreword

The United States and over 150 other countries have signed the Montreal Protocol, an international agreement to protect the stratospheric ozone layer. Under the authority of the Clean Air Act, EPA has issued regulations to phase out the production of ozone-depleting substances such as CFCs and HCFCs, widely used in refrigeration, which are harmful to the ozone layer. With very limited exceptions, CFC production and importation for domestic use ceased in the U.S. and other industrialized countries at the end of 1995. Production of HCFCs will be phased out in stages, with a complete phaseout by 2030. Other EPA regulations require recycling of CFC and HCFC refrigerants and designate acceptable alternative refrigerants.

To assist equipment owners in the transition to non-ozone-depleting refrigerants, EPA has undertaken a "Cooling and Refrigerating Without CFCs" initiative. As part of this initiative, EPA is publishing case histories which describe equipment retrofits and replacements implemented by companies around the United States. To supplement previously published case-histories, EPA presents 6 more that focus on small supermarket and restaurant chains, and their experiences with equipment and refrigerant retrofits and replacements and the use of mitigating refrigerants. A resort with various refrigerant needs is also presented to address businesses that depend on refrigeration and comfort cooling (air conditioning.)

Every effort has been made to see that these case histories accurately reflect the actions taken by the companies profiled. However, recommendations about retrofit/replacement procedures can vary. Companies are urged to check with manufacturers and local authorities in implementing programs to make the transition away from CFC refrigerants.

For fact sheets on refrigerant conversions and replacement, or to suggest possible case histories, call the Stratospheric Ozone Information Hotline number at 1-800-296-1996.



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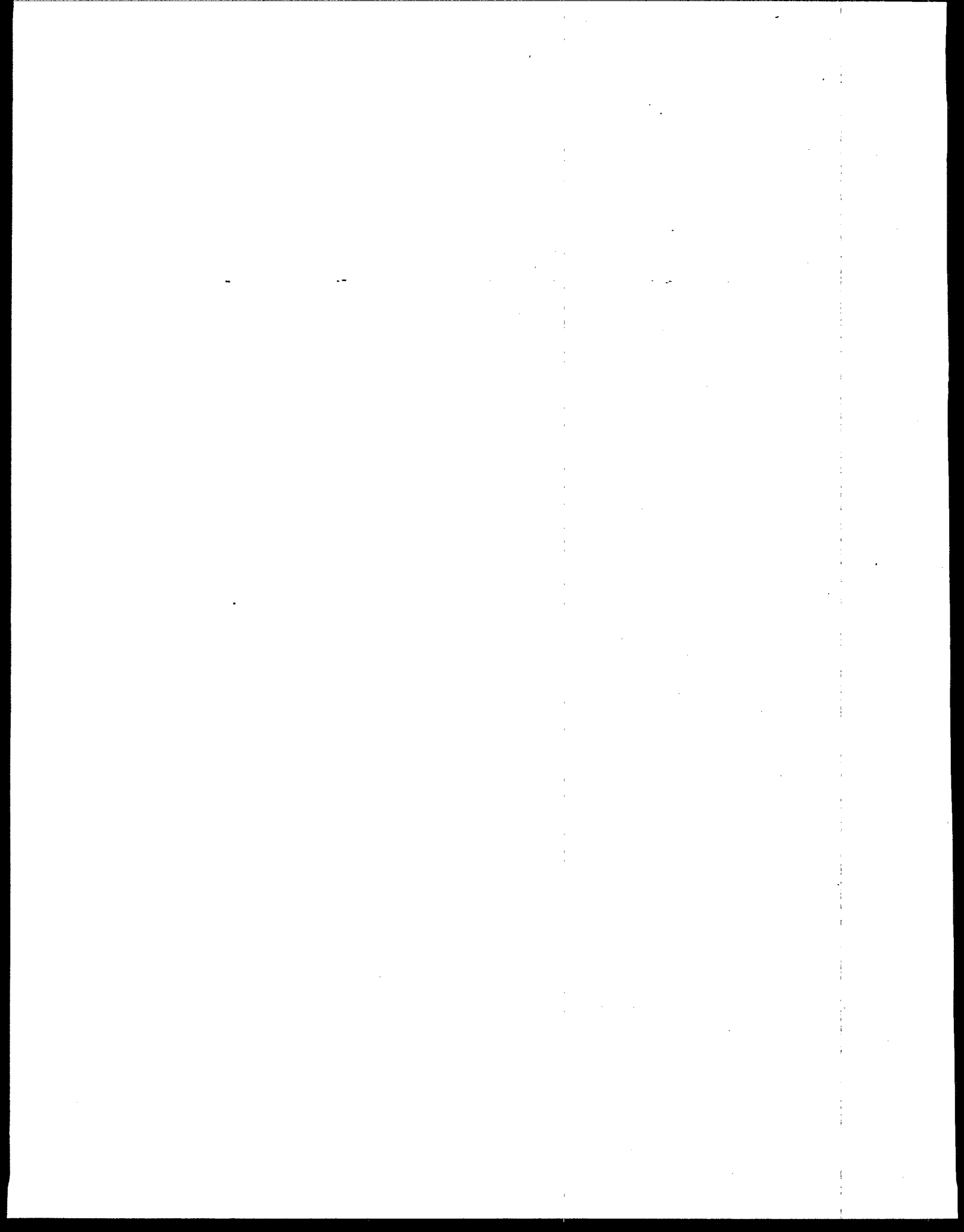
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## Stratospheric Ozone Protection Case History

# Harrah's Lake Tahoe Resort Converts Chiller and Refrigeration Equipment

Case Study:	Harrah's
Type of Facility:	Casino
Location:	Lake Tahoe, CA



The Harrah's Lake Tahoe Casino Resort is one of four casinos located in the city of Lake Tahoe. The casino/hotel covers 600,000 square feet, employs 2,400 people, hosts thousands of visitors every year, and is open 24 hours a day.

Harrah's Lake Tahoe is a good example of what education and some initiative can accomplish. This casino resort converted both its walk-in refrigerator boxes and one of its six commercial chillers to non-CFC-based refrigerants in response to the CFC phaseout.

Duane Bottoms, Refrigeration Coordinator for Harrah's Lake Tahoe, refers to the Montreal Protocol as a "wake-up call" because it forced him to closely consider the impact of CFCs on the environment. In response to the Protocol, Bottoms began looking at his options for phasing out the CFC-based refrigerants in Harrah's refrigeration systems.

First, Bottoms and his refrigeration crew at Harrah's Lake Tahoe chartered the Sierra Nevada chapter of the Refrigeration Service Engineers Society (RSES). They attended various RSES seminars on CFC-related topics and brought in instructors from nearby colleges to teach classes on improving the refrigeration, air conditioning, heating, ventilation and

electrical wiring skills of the refrigeration department. Presently, 10 crew members are EPA-certified in refrigerant recovery others are working toward certification.

The newly trained refrigeration team's mission was to find a long-term solution to the company's refrigeration needs. To accomplish this mission, the team developed a schedule to complete the conversions. To aid the refrigeration crew, Bottoms purchased software designed to help track information such as the type and quantity of refrigerant in each system, the date of refrigerant purchase, and the name of the technician who last serviced the piece of equipment, for up to 1,000 pieces of equipment. This software has created a new accountability for refrigerant usage and the condition of the equipment, to meet the twin goals of increasing energy efficiency and protecting stratospheric ozone.

Bottoms says the keys to a successful conversion process are: education, documentation, and careful planning. Through educational seminars, he was provided facts and solid, pertinent information to Harrah's upper management in order to obtain the necessary funding and approval for the refrigerant conversion program. Documentation of the company's refrigerant inventory and

equipment stock helped him track his refrigerant needs. A refrigerant management plan helped the crew think about all the available options for refrigerant conversion. Without the planning, the process would have been chaotic, with potentially adverse consequences.

### First steps

Before tackling the conversion, Bottoms wanted to ensure that he was doing the right thing by retrofitting his equipment. He hired Technical Engineering Company to conduct a study on the needs of the current refrigeration systems. The study showed the most effective first step would be to repair the current system's extensive leaks before retrofitting. High efficiency purges were installed on all the chillers to reduce refrigerant consumption. The study also revealed that problems with chilled water pumping increased energy use. It recommended converting existing chiller water piping to a "primary-secondary system" which is more energy efficient. Bottoms decided to address these needs first then proceed with the conversion.

## Refrigeration

To gain experience with alternative refrigerants and lubricants, Bottoms undertook a trial conversion of the walk-in unit refrigeration system before converting the chiller. To do this, he needed an experienced professional. He found a solution to his problem through Todd Butler, a technician employed by Hussman Corporation, who approached Bottoms about retrofitting the walk-ins at Harrah's Lake Tahoe. Bottoms then got upper management approval to undertake the initial conversion, and shortly thereafter began the conversion process for the walk-ins. Allied Signal, a refrigerant manufacturer, and Copeland, a compressor manufacturer, provided technical support during the initial conversion.

Originally, there were 20 dedicated single-compressor refrigeration units for the 20 walk-ins. Some were inefficient due to inaccessible non-insulated suction lines and equipment age (some units were 40 years old). Of the 20 walk-ins, seven were low temperature boxes using R-502 (a mix of HCFC-22 and CFC-115), and 13 were medium temperature boxes using CFC-12. Total horsepower was 30 HP for low temperature boxes and 23 HP for medium temperature boxes.

With the necessary approvals and experienced technician in hand, the next step was to choose a replacement for the CFC-12 refrigerant. At first, they wanted to use HCFC-22, but changed when a trial conversion yielded low energy efficiency results. Bottoms then decided on Gentron AZ-50, Allied Signal's version of R-507, an HFC-based azeotrope consisting of HFC-125 and HFC-143a that is more energy efficient and has a low global warming potential.

In addition, Bottoms chose to replace the old compressor systems with a Hussman Superplus rack consisting of two separate uneven parallel compressor systems mounted on the same frame. Each rack has a transducer in the suction line header that monitors the systems pressure and reports the data to a microprocessor, which in turn operates the compressors for optimum load efficiency.

One compressor system was dedicated to the low temperature applications, the other to the medium temperature applications.

For each of the 20 walk-in units, the existing mineral oil lubricant was flushed out by draining it from the system (about one quart for each change) and replacing it with pure polyol ester (POE) lubricant. This process was repeated four times to ensure that the remaining mineral oil was diluted to a tolerable concentration. During this process, the crew observed that the POE lubricant was leaking past the O-ring material in some of the older valves. All the expansion and solenoid valves in each walk-in unit were replaced. The solenoid valves were replaced to prevent leakage, while the expansion valves were replaced due to the change in refrigerant. The cooling coils were then disconnected from each old system and connected to a new parallel compressor unit. The refrigeration crew recovered 700 pounds of CFC-12 refrigerant from the old systems, which they transferred to another Harrah's location for use in other equipment. The crew then completed the conversion by charging the converted units with R-507.

## Benefits

As a result of these changes to the old systems, the total installed horsepower for the low temperature compressor system is 25 HP, although the crew has noticed that the system only uses 12.5 HP most of the time. The horsepower for the medium temperature compressor system is 22.5 HP, although most of the time the medium temperature system only uses 7.5 HP. In total, horsepower has been reduced by 5.5 HP. The new system also eliminates 30 kilowatts of electric defrost power that was previously required. In addition, there is a reduction in the total amount of refrigerant needed. Maintenance is easier because the refrigeration crew can easily check for leaks now that all the piping is accessible.

The conversion of the Lake Tahoe Harrah's walk-ins has been complete since 1994 and has run for a full year with no

problems. During that time, they have seen three benefits: decreased horsepower, reduced refrigerant use, and easier maintenance. Based on the success of the retrofit and the approval of Harrah's upper management, 25 systems at Harrah's Reno Casino have been converted. By the time the company-wide walk-in conversion is complete, at least 100 systems at other Harrah's locations will have been converted.

## Chiller conversion

The results of the first conversion convinced Harrah's Lake Tahoe to proceed with the chiller conversion. The knowledge and experience gained facilitated the conversion of its chillers at the Lake Tahoe location. Bottoms continued to educate his crew, and the crew continued to learn both in the classroom setting and "in the field." The crew is leveraging their experience and knowledge to effectively manage the casino's comfort cooling chillers.

Harrah's Lake Tahoe owns six Trane CFC-11 centrifugal chillers; of these, one has been converted to HCFC-123. The converted chiller is 16 years old, has a hermetic motor and two stages of compression. The conversion was more complicated than the walk-in conversion, as it required changes to the building in order to comply with building and fire codes. Modification of the building took four weeks, in comparison to the four days it took to actually complete the conversion of the chiller.

In compliance with fire safety codes, Harrah's Lake Tahoe has a refrigerant-specific ambient air monitor. This unit is located centrally to monitor all chillers, including the converted one. (The unit also monitors the new R-507 walk-in units, although extra piping was needed to transport air samples from the walk-ins to the leak monitor). The fire department also required that: the room be sealed to prevent air leaks, the door swing in a certain direction, audio and visual alarms be installed, and that a self-contained breathing apparatus be located outside the refrigeration room for rescue purposes

in the event of a catastrophic leak. In addition, the refrigeration crew had to undergo training on how to use the emergency equipment, provide documentation that the training occurred, and devise an action plan in case of emergency.

The county building inspector had to consult the state inspector due to lack of prior experience with HCFC-123. Building codes became an issue in this conversion, even though HCFC-123 is listed as an approved refrigerant. In order to meet the state Uniform Mechanical Code, the chiller's air purge and rupture disk (an over pressure safety device) had to be vented out of doors. Additional ventilation was also required to comply with the codes.

For the actual conversion, 750 pounds of CFC-11 were removed from the chiller and stored. Then, after replacing seals and gaskets, 800 pounds of HCFC-123 were charged into the converted chiller. The conversion required two men and took four days. The unit was rated at 400 tons of cooling capacity before conversion. After conversion, the unit was certified by the management at 365 tons cooling capacity. However, Bottoms has not noticed a difference in cooling performance: "I have not seen a difference in the [chiller's cooling] capacity. The chiller will cool all the water the pumps can supply," he notes.

The five other chillers most likely will not be converted. Three of them are in excellent condition and exhibit very little leakage. Therefore, these chillers can likely operate on the refrigerant recovered from the converted chiller for the rest of their useful lives. The other two will probably run for six more months and then will be retired. Bottoms does not seem to think this will be a problem in terms of meeting cooling needs because he expects to see the chill water use drop. With the drop in chilled water use, the old chillers will no longer be necessary, since even now they do not run at full capacity.

## Costs Recovered

The walk-in conversion cost \$132,000. The equipment cost \$57,000, while the labor to complete the conversion amounted to \$50,000. Other factors adding to the total cost included materials and warranty costs. The new refrigerant cost \$1,300, oil, \$770, and piping, \$22,430. The warranty on the new equipment cost \$2,000.

The equipment costs have been recovered due to increased energy efficiency. There has also been a decrease in horsepower use, as well as a reduction in refrigerant needed due to a more efficient leak monitoring system. The use of R-507 instead of CFC-12 in the walk-ins has saved Harrah's \$4300 per 700 pounds of refrigerant. Although the exact improvement in energy efficiency cannot be quantified due to early monitoring problems, Harrah's considers the walk-in box conversion an economic success and cites this conversion as the motivation behind converting the chiller.

The chiller conversion was less costly. The chiller parts and refrigerant leak monitor cost \$44,000 and the labor cost \$36,000. Water piping changes unrelated to the conversion added to the overall cost by \$250,000.

As a result of improved energy efficiency, Harrah's will recover the costs of purchasing the equipment for the conversion. Estimates showed that using R-507 in the refrigeration systems would reduce Harrah's electricity consumption by 62,000 kilowatt hours per year, thereby saving the company approximately \$4,500 a year in energy costs.

## The Payoff

Having a refrigerant management plan helped Bottoms and his crew think clearly about their conversion effort and gave them an overall perspective on their options. Prior to implementing a refrigeration management plan, Harrah's Lake Tahoe consumed 2,000 pounds of CFC-12 annually. Now, after conversion, they have used only 30 pounds of new

## Harrah's Chiller Conversion Checklist

- ✓ Attend educational seminars and obtain instruction on refrigeration basics pre conversion.
- ✓ Purchase a computer refrigerant tracking program.
- ✓ Study existing system to determine refrigeration needs.
- ✓ Install high efficiency purges on chillers to reduce refrigerant consumption.
- ✓ Convert walk-in cooler from CFC-502 to HFC-507 as a trial conversion.
- ✓ Insure state and county fire and building codes are met.
- ✓ Install refrigerant specific ambient air monitor in order to meet state and county fire and building codes.
- ✓ Remove CFC-11 from chiller and store for use in other Harrah's chillers.
- ✓ Replace seals and gaskets.
- ✓ Charge chiller with 800 pounds of HCFC-123.
- ✓ Monitor system performance closely during initial weeks of operation.
- ✓ Continue with routine maintenance.

CFC-12 for an annual savings of \$13,990. Furthermore, no leaks in the converted equipment have been found.

The lessons learned at Harrah's Lake Tahoe Casino Resort have been transferred to each of the fourteen other Harrah's sites. The successes of Bottoms and his crew have prompted the other Lake Tahoe casinos to take steps toward becoming CFC-free. Bottoms wants to inform the entire industry of the conversions done at the Lake Tahoe resort. He believes it will help the casino and refrigeration industries to see that they are saving money as a result of retrofitting.

## Looking Ahead

Bottoms and his crew still do not consider this program to be complete. They are currently looking to replace all 534 guest room refrigerators with Swiss absorption systems that do not use either mechanical compressors or halogen refrigerants. The dozens of small refrigerated appliances in the casino, such as drinking fountains and ice machines, must also be considered. Bottoms acknowledges that there is a certain amount of risk involved in making changes. "But the rest of the industry better get involved in this. There's not a lot of time, and a whole lot to learn."

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## Stratospheric Ozone Protection Case History

# Boddie-Noell-Hardee's: One Step Ahead of the Curve

Case Study:	Boddie-Noell Hardee's
Type of Facility:	Fast Food Restaurants
Location:	Southeastern U.S.



**BODDIE-NOELL  
ENTERPRISES, INC.**  
*"We Believe in People"*

Boddie-Noell Enterprises was founded in 1962 by Nick and Mayo Boddie and now owns 370 Hardee's franchises in seven states. Since early 1994, the Hardee's Boddie-Noell franchise has demonstrated its strong desire to be a CFC-free company.

Converting all 370 stores operated by Boddie-Noell to use alternative refrigerants is a formidable task which was not undertaken lightly. Don Campbell, Senior Director of Building Services and Utilities for Boddie-Noell Enterprises, headed the conversion team. Although Campbell tried to minimize the risk, he acted decisively by immediately converting equipment in five stores to alternative refrigerants. Upper management at Boddie-Noell gave him the opportunity to do what he thought was necessary.

### Starting Strong

In 1991, Boddie-Noell Enterprises began to focus its attention on the phaseout of CFCs. Campbell believed that his company should demonstrate strong leadership to other Hardee's franchises. His philosophy was that Boddie-Noell Enterprises needed to "act, not react" to the regulations concerning the production ban on CFCs.

Campbell formed a team of service technicians to help make important decisions. The team held meetings to discuss options, participated in seminars, and analyzed the unique refrigeration needs of fast food restaurants as well as the company's economic position. Campbell met with EPA staff to discuss the available options and upcoming regulations. The team thoroughly evaluated all the available alternatives and decided that in the applications specific to Boddie-Noell, R-401A, (a mix of HCFC-22, HFC-152A and HCFC-124), and R-402A, (a mix of HFC-125, HCFC-22 and propane), outperformed other alternative refrigerants available at the time.

They decided against the equipment change over necessary to use HCFC-22 by itself because it, too, would eventually be phased out in 2020.

DuPont provided technical assistance and helped develop a schedule to reduce the company's use of CFCs. In April 1991, Campbell selected five restaurants in which to start the conversion process and decided to retrofit all refrigeration equipment (excluding the air conditioning).

Each Hardee's store contains between 11 and 12 pieces of equipment on average which will eventually require conversion. The systems include reach-in and walk-in coolers and freezers, remote drink systems, ice machines, soft serve ice cream dispensers, salad displays, and food preparation tables.

### As Easy as One, Two, Three

Campbell hired a contractor recommended by DuPont to undertake the retrofit, even though Boddie-Noell employs its own team of refrigeration technicians. He felt his technicians were not yet suitably trained in converting equipment to non-CFC refrigerants, and wanted to ensure that everything went smoothly. First, the team did a baseline study prior to conversion to be able to compare the results of the subsequent conversion in terms of energy efficiency and performance. Then the compressors were drained of their refrigerant and mineral oils and were recharged with alkyl benzene lubricant and the new refrigerants. The whole process took approximately two hours from start to finish for each piece of equipment. In Mr. Campbell's words, "it was a tremendous success." After one year of running the first five stores with the new refrigerant and lubri-

## Boddie-Noell Hardee's Conversion Checklist

- ✓ Determine initial energy use through a baseline study
- ✓ Drain the compressors of refrigerant (CFC-12) and mineral oils
- ✓ Charge compressors with alkyl benzene lubricant
- ✓ Charge new refrigerant (R-401A) into system
- ✓ Install refrigerant tracking system to determine future refrigeration needs
- ✓ Initiate "Maintenance Retrofit" policy of retrofitting equipment when repairs are needed

cant, the team decided to complete the CFC phaseout at Boddie Noell Hardee's. At this stage, as long as it is economically feasible, the company will no longer purchase CFC-12 for any Boddie-Noell Hardee's franchise.

### Ensuring Compatibility

After the initial test conversion, a company-wide policy known as "Maintenance Retrofit" was enacted on June 1, 1994. According to the policy, if an in-house service technician has to remove CFC-12 to repair a piece of equipment, the technician must replace the CFC-12 with R-401A after completing the repair. Two concerns developed from this new policy. The first pertained to the oil's compatibility with the new refrigerant, while the second involved time. Boddie-Noell could not afford long conversion times, especially if the oil had to be completely drained with each conversion. Fortunately, solutions to these problems were soon found. The team consulted Copeland, the manufacturer of its compressors, who assured Boddie-Noell that as long as at least 50 percent of the oil in the compressors was replaced with alkyl benzene, the system

would function as it should. As a result, the conversion time was significantly reduced to 15-20 minutes per piece of equipment.

### Ensuring Reliability

Because Boddie-Noell's retrofit policy requires qualified service technicians to ensure its success, Campbell acted promptly to help his technicians receive EPA-approved certification in refrigerant-recovery practices. Every service technician was provided with a study guide and within a few weeks they were tested by the State Board of Refrigeration Examiners of North Carolina. Those who did not pass took the exam again until they did pass. The entire building services department of Boddie-Noell passed the exam and is now EPA-certified, including Don Campbell himself. Boddie-Noell also provided a seminar to its technicians on retrofit procedures.

### Costs

In Campbell's experience, converting to alternative refrigerants was not very expensive. Converting equipment during normally-scheduled maintenance did not involve significant extra costs because maintenance had to be done anyway. Since the conversion time was kept to a minimum, the technicians did not have to spend a great deal of extra time and money whenever a retrofit was needed.

### Tracking Benefits

To determine the cost effectiveness of the company's CFC reduction program, Boddie-Noell tracks the amount of purchased refrigerant, the amount of refrigerant used, the amount of recovered refrigerant, and the amount of credit received for recycling CFC-12. It has also started to track the number of service calls made to each store. To Boddie-Noell and Don Campbell, a detailed maintenance history program is more important than ever. The tracking system allows the building services department to better plan for the future and ensure a steady rate of conversion.

The conversions have actually saved the company money. Boddie-Noell has reduced its purchases of CFCs (which have risen in cost), lowered utility bills with greater energy efficiency, and sold recovered CFC-12. Furthermore, "we compared the repair costs of the converted stores to 11 similar stores of the same building type in all different geographical locations and saw no appreciable difference in maintenance costs," said Campbell.

Campbell is pleased with the results of the conversions. "We've seen declines in leak repairs and compressor failures and found an increase in efficiency, capacity and performance of equipment. Converting to new refrigerants has resulted in an annual energy savings of approximately 4.5 percent." The knowledge that CFC-12 would get more expensive in the future was also an impetus toward conversion.

### Looking Ahead

Boddie-Noell has committed to phasing out their CFC-based refrigerants as a result of the favorable economics of the conversions completed to date. The

### Payoffs of Conversion

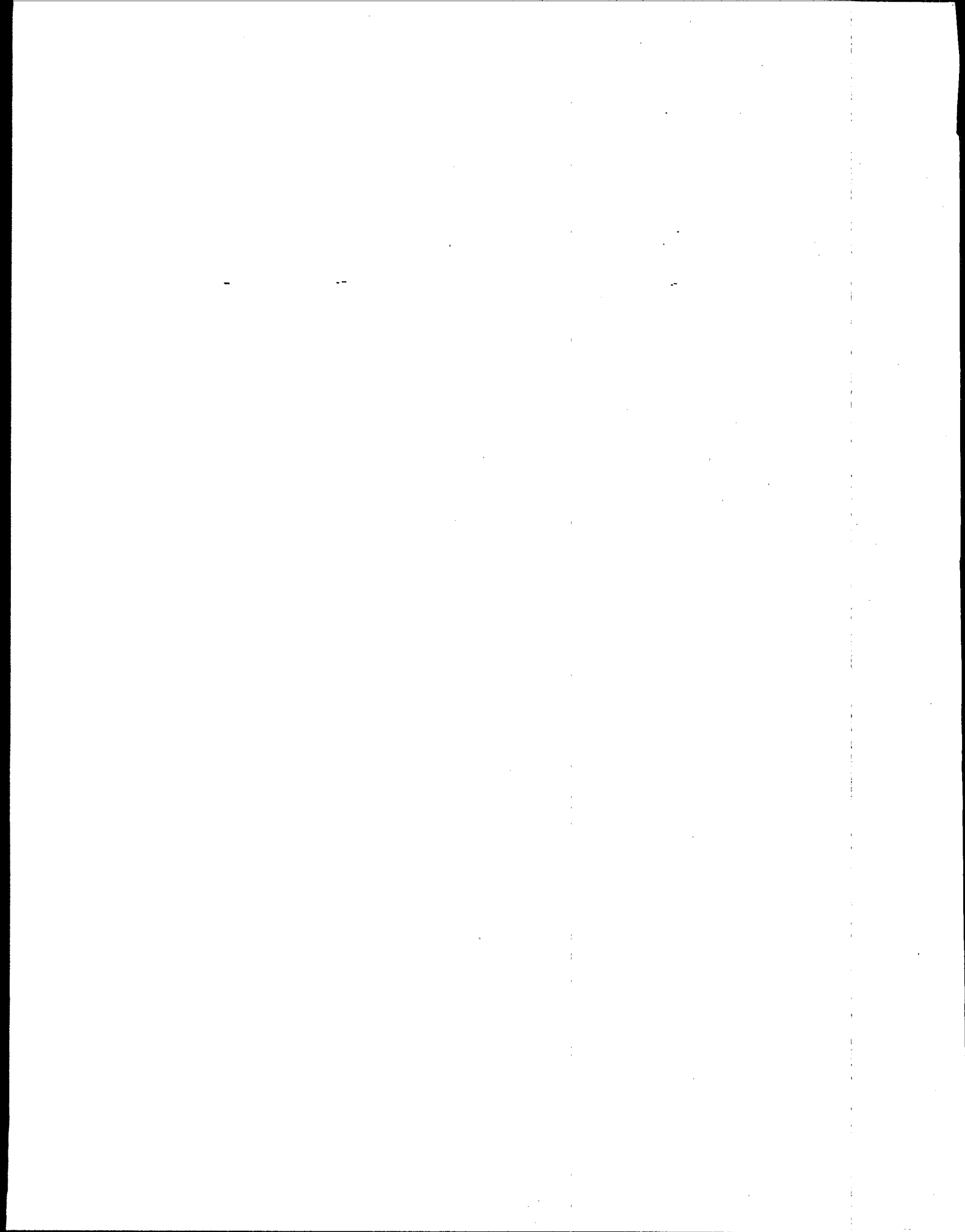
- fewer leak repairs needed
- decreased compressor failures
- decreased purchase of CFCs
- increased efficiency
- higher capacity
- better equipment performance
- energy savings

company has taken a hard look at its future refrigeration needs and institutionalized its commitment through the "Maintenance Retrofit" policy.

As Boddie-Noell's technicians continue to retrofit existing equipment when repairs are needed, the company has begun specifying R404A (a mix of HFC-125, HFC-143a and HFC-134a) for all new walk-in coolers and freezers. Similarly, HFC-134a will be specified for medium and high-temperature kitchen equipment as equipment manufacturers make the units available.

Campbell points out that he received an enormous amount of assistance and support from staff at DuPont, Copeland, HeatCraft and Polar King, in addition to the logistical and financial support from upper management at Boddie-Noell. As a result, the company is now "comfortably out of the woods."

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## Stratospheric Ozone Protection Case History

### Newark Dairy Queen: Soft-Serve With CFC Free Refrigerants

Case Study:	Newark Dairy Queen
Type of Facility:	Ice cream restaurant
Location:	Newark, DE



The Newark, Delaware Dairy Queen is a leader in the production of soft-serve ice cream and stands out in the community of 5,400 Dairy Queen restaurants. This particular franchise, owned by Butch Read and Dave Rudisill, is therefore well-known in the Dairy Queen franchise circle. To Cheri Wellman of ICI Klea Refrigerants and Emkarate Lubricants, the Newark Dairy Queen franchise provided an ideal opportunity to demonstrate the effectiveness of ICI Klea's alternative refrigerants. Wellman contacted Read and Rudisill and offered to show them the benefits of switching to CFC free refrigerants. At the same time, the Newark Dairy Queen owners had begun investigating whether alternative refrigerants could extend the life of their machines past the date of the CFC production ban. Read and Rudisill agreed to work with ICI on a demonstration project.

#### The Conversion

Wellman's assistance made the retrofit at Newark Dairy Queen easy. This store has a combination of 10 soft-serve ice cream machines. Since his was a demonstration project, Read decided to convert two of Newark Dairy Queen's machines. One machine used CFC-12 and the other

machine used R-502 (a mixture of HCFC-22 and CFC-115). The contractor, Refrigeration Specialists, retrofitted the units to HFC-134a and R-407B (a mix of HFC-32, HFC-125 and HFC-134a) respectively. Each twin (double compressor) machine took approximately eight hours to convert. The conversions were done on two mornings, before the store was open for business.

The first morning was spent removing the existing lubricant (mineral oil) and flushing the system with new polyol ester lubricant. This was necessary because the new refrigerants are not compatible with conventional mineral oil. The flushing process helps remove the mineral oil from the system. The second morning was spent recovering the old refrigerant, changing the oil again, replacing filters, and finally charging the equipment with the new refrigerants. It was also necessary to adjust or replace pressure controls, since the new refrigerants operate at slightly higher pressures.

Total costs to retrofit each machine, including parts and labor, amounted to only \$600. ICI supplied the refrigerant and lubricant.

#### Conversion Checklist for Newark Dairy Queen's Soft-serve Ice Cream Machines

- ✓ Remove existing mineral oil because mineral oil is incompatible with the new refrigerants.
- ✓ Flush the system with new polyol ester lubricant because of compatibility with new refrigerants.
- ✓ Recover old refrigerant.
- ✓ Change oil once more to insure compatibility.
- ✓ Replace filters.
- ✓ Charge equipment with new refrigerants HFC-134a and R-407B.
- ✓ Adjust pressure controls for the new refrigerants.

## Results

Since the conversion, no significant modifications to the machines have been required, despite the fact that one unit was already 17 years old. The amount of new refrigerant required by the machines was about 90 percent of the weight of the CFC charge. Read and Rudisill noted no loss in cooling capacity, even in hot summer months. Employees didn't even notice any change in the firmness of the soft-serve.

Read and Rudisill have held up their end of the bargain. They publicized the conversions in a newsletter put out by the Dairy Queen Operators Association. They have also volunteered to share the benefit of their experience with any other Dairy Queen operators who are interested

in converting. Wellman reports that one owner of 66 stores has recently contacted ICI and is interested in learning more about the new refrigerants and lubricants.

## Future plans

Read and Rudisill are eager to continue converting their equipment away from CFCs. Judging by their attitudes, the conversions have been a big success. Read says his goal is to continue to convert the soft-serve machines as they lose the CFC charge, and to eventually retrofit the entire store.

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### Costs of Converting

- new refrigerant
- new lubricant
- contractors

### Benefits of Converting

- + less refrigerant used
- + long term refrigerant in place pre-CFC phaseout deadline
- + extended life of equipment
- + no loss in cooling capacity



## Stratospheric Ozone Protection Case History

# Seaway Food Town SuperStore Goes CFC Free

Case Study: Seaway Food Town, Inc.

Type of Facility: Supermarket

Location: Monroe, Michigan



Seaway Food Town, Inc., is a regional grocery store chain headquartered in Maumee, Ohio. The company's experience with converting to non-CFC refrigerants was different from most other companies that have undertaken conversions: Food Town chose to convert equipment in a new superstore being built in Monroe, Michigan, rather than converting older equipment in an existing store. The alternative refrigerant Food Town chose for its conversion was Gentron AZ-50, Allied Signal's version of R-507 (an azeotropic mixture of HFC-125 and HFC-143a), has performed so well in the new store that the company has made plans to convert all 68 of its supermarkets to the refrigerant.

### An Aggressive Policy

Seaway Food Town relies on its contractor, Arco Refrigeration, to fulfill all of its refrigeration, general maintenance and construction needs. In 1993, Tom Archambeau, President of Arco Refrigeration, decided it was time to take action in response to the CFC phaseout. He felt he could best maintain control of the situation by adopting an aggressive response policy to the phase-out. He sent notices to all of his clients recommending that they be "aggressively conservative"

by converting to non-CFC based refrigerants ahead of EPA's schedule to avoid the risk of paying a high price or not being able to obtain refrigerant when needed. Bernie Crouse of Seaway Food Town, a long-time customer, decided to begin testing the different refrigerants available.

Seaway Food Town decided to use the new superstore it was constructing in Monroe, MI as a test for the new refrigerants. When this store was finished, it would comprise a 55,000 square foot facility supporting a Chinese restaurant, pizzeria, bakery and photo lab. As a result, the store would have a variety of refrigeration needs.

Seaway made the decision to use HFC refrigerants immediately instead of prolonging conversion by using HCFC-22, which is also scheduled for phase-out in 2020. According to Crouse, "R-507 was a smarter choice than HCFC-22 for replacing both R-502 (a mix of HCFC-22 and CFC-115) and CFC-12 in low and medium temperature refrigeration applications. Since R-507 is a long-term, HFC-based alternative, there will be no need to retrofit the system later on, saving us time and money."

### Equipment Needs

The key factor in judging the success of this endeavor would be operating efficiency and amount of maintenance required. Crouse relied on a team of refrigeration experts to build the refrigeration systems for the store. He wanted the systems to meet long term refrigeration needs and remain relatively maintenance-free. Arco worked closely with Kysor/Warren, Allied Signal, and Refron, a refrigerant wholesaler, to ensure success.

The equipment installed included four Kysor/Warren uneven parallel racks (two low temperature and two high temperature), outfitted with total rack controllers by Computer Process Controls, and 18 Copeland semi-hermetic "Discus" compressors ranging from four to 15 horsepower (HP). Each rack serves approximately 12 systems connected to roughly 28 display cases and is connected to an alarm system that monitors refrigerant temperature, head and suction pressures, liquid levels, and condenser fan operation. In case of a problem, the tracking system signals a control room and a technician. Every display case has a liquid line shut off valve. If the system should need repair, the store can fix the

problem by using the shut off valves, eliminating the need to recover the entire refrigerant charge.

The technicians installed the equipment within a month's time, with support from Kysor/Warren and Allied Signal. The R-507 systems are configured much like R-502 systems. Before the start up, the technicians charged the systems with a synthetic polyol ester (POE) lubricant. The systems were then charged with 2,800 pounds of R-507. After start-up, the systems were charged with eight additional gallons of POE lubricant to make up for oil circulation in the piping. Since the start-up, the systems have functioned like the systems using R-502, yet run with a "six to eight percent increase in capacity for the same amount of horsepower" remarked Archambeau. Since both R-502 and R-507 are azeotropes, and therefore behave similarly, the need for service calls is not expected to change drastically either.

## In The Clear

Crouse and Archambeau had different concerns about the new refrigerant and lubricant used in this project. Crouse's main concern was controlling the amount of moisture in the system, since POE lubricants are known to absorb moisture from the air. Archambeau solved this problem by putting each system into a hard vacuum and changing the oil two to three times in the beginning. Archambeau worried most about the availability of R-507. "At the time, it was difficult to get such a large amount of HFC-based refrigerant. It could easily take six to nine months (from time of order)." Now, HFC-based refrigerants are readily available and lead times for large shipments are minimal.

Of some concern was the performance of R-507 in comparison to R-502. However, Seaway Food Town has not seen any problems in that respect. R-507 functions like the CFC refrigerant.

From the start of this project, Crouse was forward-thinking. According to Archambeau, "Food Town had the foresight to make the switch when they did. Some people didn't believe EPA and

thought they would always be able to get CFCs." Converting to HFCs has saved Food Town time, money and concern about keeping their store in working condition. Mike Noss, an Arco technician on the team, concurs: "R-507 is an excellent alternative to R-502 considering that the servicing aspects of the refrigerants are virtually the same."

## Preventive Maintenance

Crouse also had the foresight to know he needed to build the new systems for easy maintenance. Seaway Food Town now employs an Arco team that regularly checks and tunes the system and keeps the store leak-free. Preventive maintenance cuts down on food loss, refrigerant loss, and service time because it significantly decreases the need for major service repairs.

## The Next Step

The converted superstore refrigeration system runs so well that Seaway Food Town decided to convert its other 67 stores. Each complete store conversion takes approximately one-and-a-half weeks. At present, the conversion program is 60 percent complete.

All of the newly-built stores use R-507 for both the low and medium temperature needs. Existing stores are typically converted from R-502 to R-507 for the

low temperature applications and from CFC-12 to HFC-134a for the medium temperature applications. Small self-contained equipment has not yet been converted because leaks are not a problem and thus availability of replacement CFCs is not a concern. According to Archambeau, Seaway has enough CFC-12 to keep its older machines running until they are finally ready to be replaced. At that point, Seaway will replace them with HFC-134a equipment.

## The Payoff

In total, Seaway will have spent over \$2 million when the conversions of all 68 Seaway stores are complete. However, the company believes it has come out ahead financially, in terms of decreased business risk, increased energy efficiency, increased capacity, and decreased consumption of both refrigeration lubricating oils and the more expensive CFC refrigerants. Seaway has also become a recognized leader in the area of environmental protection for its role in reducing the use of CFCs.

## Looking Back and Future Plans

All parties involved in this program have been committed to the conversion from the start. No one has seriously considered rethinking the decision to convert.

### Costs of Converting

- refrigeration equipment
- labor for installation
- conversion of 68 stores

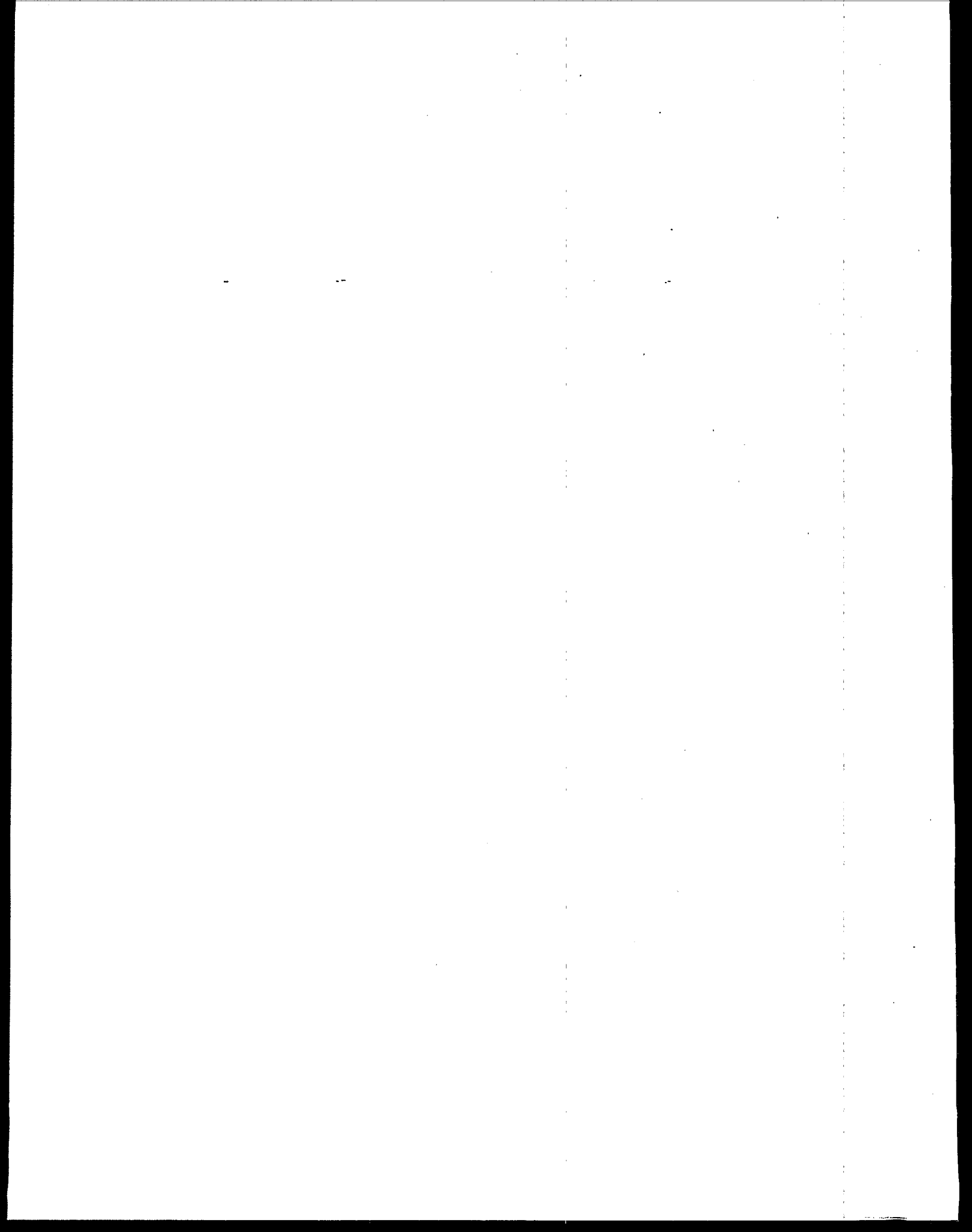
### Benefits of Converting

- + increased energy efficiency
- + increased capacity
- + lower business risk
- + reduced purchasing of oil
- + decreased purchasing of expensive refrigerants
- + less use of CFCs

Both Crouse and Archambeau say they would not change a thing, as the conversion was free of major incompatibilities and problems. The progressive thinking of Crouse and Archambeau paid off for all the parties involved.

Seaway Food Town hopes to be CFC free within the next 24 months, and at the rate they are going, they should certainly achieve this goal. The lesson Archambeau has to offer after all his experience in converting? "Stick to refrigeration basics, and you'll be fine."

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# Stratospheric Ozone Protection

## Case History

### Dierbergs Supermarkets: Steadily Becoming CFC Free

Case Study:	Dierbergs
Type of Facility:	Supermarkets
Location:	St. Louis, MO



Dierbergs Supermarkets, a small family-run business based in St. Louis, MO waited and watched other stores convert to new refrigerants before forging ahead on its own. As a result, the company has learned some lessons about costs and planning ahead which have helped save the company money.

Dierbergs owns and operates 14 grocery stores, with another one currently under construction. Although the chain is relatively small, its stores are quite large, averaging 75,000 square feet. Each store has its own commissary and bakery where fresh salads, meats and baked goods are prepared daily. In addition, the chain's floral operations make it the largest FTD retailer in Missouri.

#### Getting the Green Light

Bob Francis, Dierberg's Director of Engineering Services, is responsible for managing the company's refrigeration system. He undertook the first initiatives regarding Dierberg's refrigerant conversion by approaching the chain's owners and their family members with his plan for managing the CFC phase out. His approach included investigating available options and moving at the most economically opportune time. This allowed

the owners to maximize the cost-effectiveness of their "retrofit dollars." Although a strict budget was never drafted for the conversions, the owners took a careful look at the costs involved and decided to approve a 10 percent increase in the service budget to move the conversion process along.

#### Clearing the Path

Too small to support its own maintenance and construction staff, the company relies on outside contractor support. Francis worked closely with his outside contractor on the CFC phaseout issue.

The path to retrofiting can be quite confusing because of the number of alternative refrigerants available. Determining which alternative will be optimal for a given application can be confusing if information on the alternatives is not readily available. Therefore, before Francis even started to research alternative refrigerants, he set up an Energy Management System (EMS), called Comptrol with the capability to monitor kilowatt-hours and run time, as well as amount of discharge and suction pressures for refrigeration systems. This system has saved Dierbergs time and money by allowing them to

#### Dierberg's Conversion Checklist

##### CFC-12 → HFC-134a

- ✓ Install Comptrol - an Energy Management System with the ability to monitor kilowatt hours, run time, amount of discharge and suction pressure.
- ✓ Recover existing mineral oil from the compressors.
- ✓ Change lubricant four times to flush out additional oil circulating in the waste heat reclaim system.
- ✓ Charge system with new refrigerant.
- ✓ Monitor the system for 30 days.
- ✓ Make any necessary adjustments such as upsizing the compressors.
- ✓ Continue with other trial conversions before making a final decision.

easily access key energy consumption parameters, and has provided valuable insights for the retrofit by providing data with which to evaluate relative performance.

## Testing the waters

Using Food Marketing Institute (FMI) guidance materials, Dierbergs began its CFC elimination program by changing its R-502 (a mix of HCFC-22 and CFC-115) medium systems to HCFC-22. The power heads on the expansion valves and refrigerant were all changed, but the compressors were retained. Francis was pleased with the results, but when he realized that HCFC-22 was not a long-term solution to his problem, he began to investigate alternative options, such as HFC-134a.

Dierbergs' first conversion system using long-term alternatives involved a red meat case. The company received technical support from Sporlan Valve Co., Copeland, and Hussman, its manufacturers of refrigerant metering valves, compressors, and display cases, respectively. The conversion took 12 hours of labor time. The lubricant was changed from mineral oil to polyol ester before charging the new refrigerant. The lubricant was changed four times, as opposed to the typical three, to flush out additional oil circulating in the waste heat reclaim system.

After the technicians finished the lubricant change, the new refrigerant was charged in the systems.

The CFC-12 system was converted to HFC-134a with no problems. However, after 30 days of monitoring, the service technician found that HFC-134a was not as effective as the CFC-12 at operating temperatures lower than 20 degrees. The compressor lost cooling capacity when operating with HFC-134a, and consequently had to be up sized.

Dierbergs also wanted to test other alternative refrigerants. It tested R-407A (a mix of HFC-32, HFC-125 and HFC-134a), with R-404A (a mix of HFC-125, HFC-143a, HFC-134a) as an alternative to R-502. In both instances, R-407A was five to seven percent more energy efficient than R-404A. In 1993, the company tried its first R-507 (HFC-125 and HFC-143a) retrofit. Three identical glass door systems were run with R-502, R-507, and R-404A. In the converted systems, R-507 performed slightly better than R-404A.

## Decisions

Due to the large number of alternative refrigerants available, Francis had a formidable decision before him. He ultimately decided to replace all existing R-502 applications with R-507 and all CFC-12 applications with HFC-134a. New stores will use R-507 in all temper-

ature applications. Although Francis was pleased with the energy results from the R-407A conversion, he hesitated to convert to R-407A because at the time of these conversions, Copeland had not yet approved this alternative for use in its equipment.

Presently, Dierbergs has set a few ground rules regarding conversions. It no longer buys any new equipment with CFC-12 or HCFC-22, except for HCFC-22 air conditioning. As refrigerant is needed, Dierbergs converts other systems and uses the recovered refrigerant to re-stock its refrigerant inventory "just-in-time." Furthermore, all retrofits are done on a Monday, Tuesday or Wednesday morning, when store traffic at the store is slowest.

By moving ahead cautiously, Dierbergs now pays only \$5 dollars less per pound for its R-507 refrigerant than when it was introduced. Because it shows great promise as an energy-efficient performer, Dierbergs may move to R-407A later if: (1) Copeland has approved its use in its compressors, (2) the economics are right and (3) the industry has sufficient experience with the refrigerant.

## Lessons learned

Dierbergs noted that in converting CFC-12 systems to HFC-134a, the refrigerating capacity of the expansion valves increased by as much as 20 percent. Therefore, adjustments on valves for lightly-loaded systems or outright replacements were necessary.

Dierberg's outside contractor currently is performing conversions "just-in-time," meaning that as the supply of replacement refrigerant stock gets low, he converts some systems and moves the recovered refrigerant to storage. The rate at which he is required to do this is quite low because the chain has good control of its refrigerant consumption. The company is also trying to use up its stockpile of CFC refrigerants. However, because its stores have such low leak rates, this stockpile will take some time to

### Costs of Converting

- installation of Comptrol
- purchase of new refrigerants
- cost of labor

### Benefits of Converting

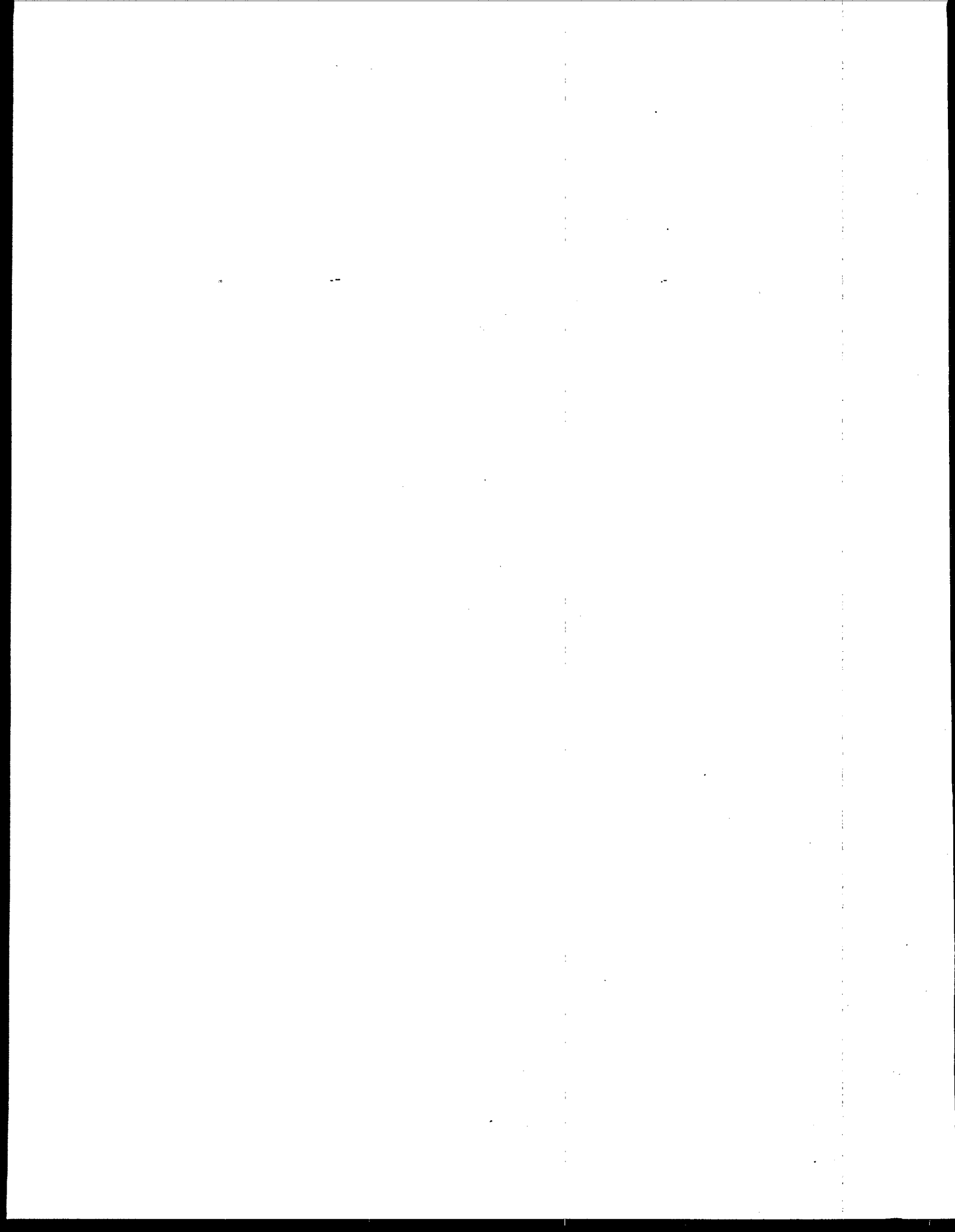
- + less refrigerant used
- + lower cost of refrigerants
- + minimal store interruptions
- + increased energy efficiency
- + chain is 25-30 percent CFC free ahead of CFC phaseout

deplete. The contractor tracks the amount of refrigerant used in each of the 14 stores to help manage the stockpile of refrigerant.

Conversions also occur during minor remodels and planned construction involving refrigeration systems, such as case replacements, where systems may be taken out of service as a normal business activity. As a result, Dierberg's minimizes business interruptions. Currently, the chain is 25-30 percent CFC free. Due to solid refrigerant management practices Dierberg's is on its way to complete conversion to alternative refrigerants.

The conversions at Dierbergs have tremendously benefitted Francis and the owners of Dierbergs by helping to minimize Dierbergs' costs. By waiting for prices of alternative refrigerants to come down before undertaking its conversions, the company was able to save money on its refrigerant purchases. Dierbergs is following the letter of the law, keeping within its approved budget, and will eventually be CFC-free at low cost.

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## Stratospheric Ozone Protection Case History

# Independent Retailer Begins Transition to Alternative Refrigerants

Case Study:	Quail Plaza and Market Plaza IGA
Type of Facility:	Supermarkets
Location:	Oklahoma City, OK



Mike Snyder is an independent retailer and the proprietor of the Quail Plaza and the Market Plaza IGA Supermarkets in Oklahoma City, OK. Because his business is relatively small, he has to personally fill numerous roles and take on more responsibility than a typical store owner. He finds himself learning something new everyday as he keeps up with all the latest developments in the supermarket industry including the phaseout of CFCs.

### The Quail Plaza Store

In 1992, Snyder decided it was time to remodel his two stores, starting with Quail Plaza. The refrigeration equipment at both stores had become outdated. John Terrell, proprietor of Terrell Refrigeration (Snyder's refrigeration maintenance contractor) advised him that it would be an opportune time to change refrigerants as well.

The expansion and remodeling of the 20-year-old Quail Plaza store introduced Snyder to the new line of alternative refrigerants. Snyder had a great deal of confidence in Terrell because Terrell had been his service contractor for a number of years and had prior experience with alternative refrigerants. At Terrell's

recommendation, Snyder retired his old CFC-12 and R-502 (a mix of HCFC-22 and CFC-115) equipment and replaced it with equipment using HCFC-22.

At the time, HCFC-22 was the industry standard for conversions: the industry had significant past experience with HCFC-22, the cost of purchasing HCFC-22 was significantly lower than the cost of CFC-12, and there was a 2020 phaseout date for HCFC-22. In addition, Terrell had a great deal of experience converting a 14,000 square foot walk-in cooler to HCFC-22, and had installed two compound refrigeration racks using HCFC-22 in another store.

The Quail Plaza store used both R-502 and CFC-12 in its existing systems. During the remodeling, the store was outfitted with two new large parallel racks (one for low temperature applications and one for medium temperature applications). These new racks replaced the old equipment.

According to Snyder, moving to alternatives was straight-forward. During the replacement, the old systems were removed, the refrigerant was recovered and sold back to the refrigerant reclaimer, and the new systems were installed. Because the equipment installation had to

be closely coordinated with the other remodeling activities the job took two months with two men working at the store about 75 percent of their time.

### The Market Plaza Store

Almost a year after completing the Quail Plaza remodeling, Snyder and Terrell began to remodel the Market Plaza store. This store expansion provided an opportunity to test new refrigerants through the installation of new equipment. The 15-year-old store was reconfigured to make room for a new deli and additional produce. A frozen bakery case was also added.

The store originally used four parallel racks for its refrigeration needs, and operated on a single refrigerant, R-502. An additional rack was installed to serve the new medium temperature refrigeration loads. The rack operates on 650 pounds of HCFC-22 and is connected to 12 new medium temperature systems. Terrell specified HCFC-22 in the new rack because it is well suited for use in medium temperature applications.

In addition, a new dedicated rooftop unit was installed to handle the new low temperature frozen bakery case. It was placed on the roof in order to be in close proximity to the case it served.

Terrell specified R-404A, a mix of HFC-125, HFC-143a and HFC-134a, as the alternative refrigerant for the new rooftop unit, for a number of reasons. By this point, Terrell had gained more experience with R-404A and he believed the industry was moving toward this particular refrigerant. Terrell convinced Snyder to use R-404A instead of HCFC-22 for the bakery case in order for Snyder to gain experience with this alternative refrigerant. Additionally, R-404A was a more energy-efficient and low-maintenance refrigerant for low temperature applications than HCFC-22.

The four original racks in the Market Plaza store have not yet been converted, but Snyder plans to convert them in the near future. These four original racks use R-502 as the refrigerant and serve a combined 26 systems. By converting one rack at a time and keeping leak rates low, Terrell expects that Snyder can operate the remaining equipment for at least three more years without additional purchases of CFC refrigerant.

## Results

So far, the company's experience with the new equipment at both stores has been excellent, with no refrigerant leakage and low maintenance costs following the initial commissioning of the equipment.

## Lessons Learned

The changes at the two stores provided opportunities for learning some lessons about the performance and requirements of HCFC-22 and R-404A in commercial refrigeration applications. "When working with HCFC-22," Terrell stresses, "it is important to adjust the expansion valve carefully to avoid overheating problems at the compressor, and when working with polyol ester (POE) lubricant [in HFC systems], it is important to keep moisture from the air out of the lubricant." Terrell recommends the maintenance of a high vacuum for 24 hours for this type of system to verify that no leaks are present and to dry out the system. After initial operation, he recommends that the filter-driers be changed because POE is also a good solvent and will transport all construction-related debris (such as carbon deposits or flux) back to the filter-drier.

In terms of management lessons, Snyder believes in timing the conversion of these remaining systems to take maximum advantage of industry and con-

tractor experience with alternative refrigerants and lubricants. Conversions should also be scheduled to allow a reasonable amount of time to budget money for the conversion to new alternatives.

## Sound Advice

The transition to new refrigerants can be more difficult for an independent retailer who typically does not have the same technical resources as the larger supermarket chains. As Snyder explains, "the upcoming CFC phaseout presents new challenges for independent retailers. Among these are conversion costs and the necessity to plan the conversions to avoid disruptions and maintain product quality." He stresses the importance of researching new refrigeration regulations, and having a game plan in place. He points out that independent retailers can gain a tremendous amount of knowledge from other independents who have undertaken a conversion away from CFCs. For example, Snyder benefitted not only from Terrell's guidance, but also from observing the experience of Mayfair Market IGA, another Oklahoma City supermarket that recently made the conversion to alternative refrigerants.

Snyder is working towards a smooth transition into the 21st century by decreasing his reliance on CFCs. As a result of his efforts to date, Snyder has also become more involved and educated

### Costs of Converting

- new equipment
- new refrigerants
- contractors

### Benefits of Converting

- + experience with long term refrigerants
- + better leak control
- + lower maintenance costs
- + prepared for transition into 21st century
- + better educated on refrigeration basics

in the refrigeration field. This involvement will continue to benefit him as he converts the original equipment at Market Plaza. Now, with the new refrigeration equipment running smoothly, he can concentrate on the next phase of his transition to alternative refrigerants.

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